

Introduction

Tunnel engineering is a branch of Transportation engineering which deals with the planning, designing, construction, operation and maintenance of tunnels to ensure safe and effective transportation.

Tunnel

It may be defined as under passages driven horizontally through the ground or water without disturbing overlying soil, rock or water.

Advantages of Tunnel:

- It can shorten the distance, instead of going over or around a hill or a mountain.
- Tunnels can be of fairly consistent temperature may not freeze or be too hot.
- They provide protection from rain, snow and other and other natural influences thus saving maintenance cost.
- Traffic noise is reduced.
- Cost of hauling is decreased due to lighter grades are possible in tunnels.

Disadvantages of Tunnel:

- Construction of tunnel requires long time.
- Specialised equipment and techniques makes tunnel costlier.
- Skilled labours are required for construction of tunnels.

Types of Tunnel

Tunnels can be broadly classified on the following basis:

1. Classification based on the purpose:

i. **Traffic Tunnels:** - As the name suggest it is used for carrying traffic under water or underground where over bridge and cutting of rock is not possible.

Examples:

- **Railway Tunnel:** used for carrying railway traffic.
- **Highway Tunnel:** used for carrying highway traffic.
- **Pedestrian Tunnel:** used for carrying pedestrian traffic.
- **Subway Tunnel:** used for carrying pedestrian traffic for crossing road.

ii. **Conveyance tunnels:-** It is used for conveying utilities such as:

- **Hydro-electric power Tunnel:** used for conveying water from dam to turbine.
- **Water supply Tunnel:** Used as a water supply network system for conveying water.
- **Sewer Tunnel:** used for conveying sewage.

2. Classification based on the Methods of Tunnel Construction:

- **Cut and Cover Tunnel:** These are built by excavating a trench the, constructing concrete structure in the trench and covering the soil.
- **Bored Tunnels:** These are built by using the method of boring. They are named according to the material through which they pass Such as:
 - (a) **Rock Tunnel:** for hard rock construction drilling and blasting is used, for soft rock TBM (tunnel boring machine) is used.
 - (b) **Soft Ground Tunnel:** Excavated through soil using shield or by TBM.
- **Immersed Tunnel:** these are precast concrete structure which is placed in prepared trench below water.
- **Jacked Box Tunnel:** are pre-fabricated box structure jacked horizontally through the soil using method to reduce surface friction. Normally used where surface must not be disturbed like beneath runway, embankment, or any busy road.

3. Classification based on alignment:

- **Saddle and Base Tunnel:** Tunnel constructed through valleys along natural slope as long as this natural slope does not become steeper than ruling gradient of the route.
- **Spiral Tunnels:** It is constructed through narrow valley where the natural gradient is steeper than ruling gradient. In order to provide smooth and safe movement of traffic, the additional length for minimum permissible radius is obtained by forming a loop into the interior of mountain.
- **Off Spur Tunnel:** Short length tunnel constructed to negotiate minor obstacles.

Site Investigation

It is the process of collecting information about the engineering properties of soil and rocks of concern site and evaluating and checking the feasibility of site for the construction of tunnel. Site investigation of tunnels normally deals with following:

1. Geotechnical Investigation: It is the process of collecting information about soil of site.

Objective: the primary objective is to determine

- Physical properties of soil.
- Mechanical properties of soil such as strength and compressibility.
- Chemical composition of soil.
- Selection of excavation method.
- Assessment of cost.
- Assessment of stability.

2. Geological Investigation: It is the process of collecting information about rocks. It served the following purpose:

- Selection of tunnel route.
- Selection of excavation method.
- Selection of design for tunnel.
- Assessment of cost.
- Assessment of stability.

Site investigation for tunnel accomplishment in the following stages:

1. Investigations prior to planning.
2. Investigations made at the time of planning.
3. Investigations made at the time of construction.

Investigations Prior to Planning

- Geological Investigations- relation between bed rock and top soil.
- Morphology, Petrology, Stratigraphy.
- Determination of positions of weak zones- faults, folds and shear zones.

Investigations made at the time of planning

- Holes are drill at various places on the proposed routes of tunnel for further detail investigation.
- Shaft (vertical tunnel) can also be excavated in place of holes if possible for deep investigation of routes such as faults, folds, and shear zones.

Investigations made at the time of construction

- **Heading-** part of tunnel cross section excavated for small lengths, it can be top, bottom or side excavation for further detail investigation.
- **Drift-** part of tunnel cross-section excavated for entire length of tunnel
- **Heading and drift give information about:**
 - ☞ **Rock Stratification**
 - ☞ **Thickness of layers**
 - ☞ **Constituents**
 - ☞ **Structure and texture of rock**
 - ☞ **Temperature**
 - ☞ **Possibility of land slide and rock fall.**
 - ☞ **Under ground water level.**